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Office Memorandum • UNITED STATES GOVERNMENT

TO : The Files

DATE: 19 December 1956

FROM : [redacted]

25X1

SUBJECT: (Contract RD-107, Task Order 3

[redacted]

ILLEGIB

1. On 14 December 1956, a meeting was held at the [redacted] to discuss progress on the subject contract. Present at the meeting were: 25X1 25X1

[redacted] 25X1

2. The ferrite development program was originated as a result of a [redacted] antenna development which showed broader band and higher gain characteristics than would normally be expected from an antenna of that size. The poor antenna gains demonstrated by the antennas developed under this task order, the theoretical calculations presented in the fifth and sixth monthly letter reports and the experience with the VLF ferrite antenna have warranted a re-examination of the [redacted] antenna experiments. This re-examination is now in progress but initial results indicate that there may have been experimental errors due to re-radiation from [redacted] the AC line. Thus, at least part of the high performance that we have been led to expect from the ferrite development program appears to have been based on misinformation. 25X1 25X1 25X1

3. There is one characteristic of ferrite, called dispersion, which still offers promise of broader band (but not higher gain) characteristics than would normally be expected. This characteristic is demonstrated in Figure 1 which shows permeability of the ferrite as a function of frequency. In the indicated portion of the curve, permeability (and therefore inductance) decreases with frequency. Since the resonant frequency of a tuned circuit is inversely proportional to the square root of the inductance, it can be seen that in this portion of the curve, the ferrite antenna will be resonant over a wider range than if the inductance were constant. If the permeability were inversely proportional to the square of the frequency, it would be possible to design the antenna to be resonant over the entire sloping portion of the curve. Experience thus far with ferrites has indicated that the inductance is inversely proportional only to the first power of the frequency, but even this will have the effect of almost doubling the band over which the antenna is resonant. All materials tested thus far have also shown that the losses of the ferrite increase in this same frequency range. It will be the goal of Phase B of this program to discover materials whose inductance varies with the square of the frequency and whose lossess do not increase in the same region.

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4. The fifth monthly letter states that for the case in which an antenna is matched to its load, the appropriate figure of merit is as shown in Figure 2. The permeability which appears in the equation is the effective permeability. The effective permeability is related to the intrinsic or toroidal permeability, as shown in Figure 2. This curve shows that unless the length to diameter ratio is high, increasing the permeability of the material will not greatly improve the quality of the antenna.

5. [redacted] was asked to explain the "theoretical gain of narrowband unit relative to a half wave dipole" curve shown as Figure 7 in the fifth monthly letter report. He stated that the gain improved at higher frequencies because less loading was required to obtain the thirty megacycle bandwidth used in the equation. The ferrite antenna will reach a gain of 0 db with respect to a dipole if there are no losses and if the permeability is infinite at that frequency at which ~~the length of~~ the ferrite rod is one-half wave length long.

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$L \propto \mu_e$ $\quad F_o = \frac{1}{\sqrt{LC}}$

$\therefore L = \frac{1}{F_o^2 C}$

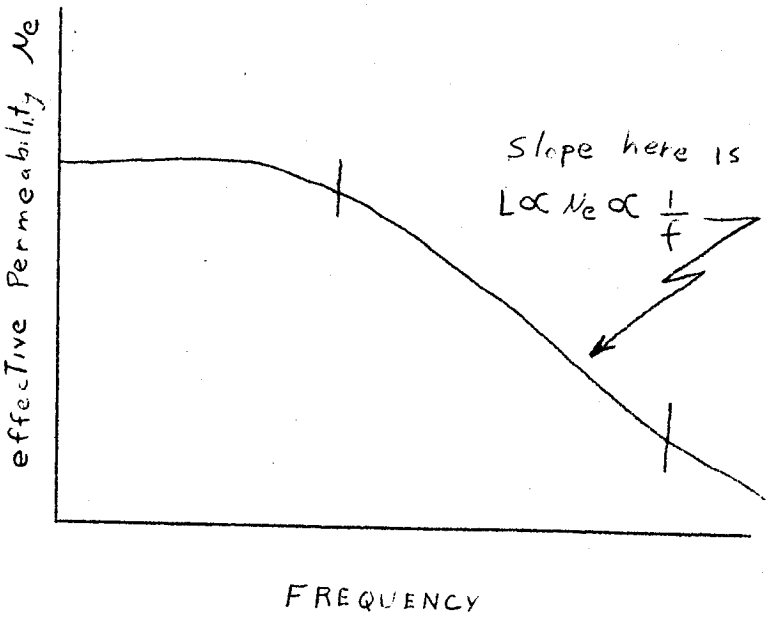

Fig. 1

Figure of Merit (matched Load) $= \frac{h^2 Q}{L} \propto \mu_e A Q_o$

μ_e – effective Permeability

μ_i – intrinsic or Toroidal Permeability